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First record of an Odontaspidid shark in Ascension Island waters

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The occurrence of the poorly understood shark species Odontapsis ferox is reported at an oceanic seamount in the central south Atlantic, within the Exclusive Economic Zone of Ascension Island. The presence of the species at this location is confirmed by the discovery of a tooth embedded in scientific equipment, and footage of at least one animal on autonomous underwater video. The new record of this shark species at this location demonstrates the knowledge gaps which still exist at many remote, oceanic structures and their candidacy for status as important conservation areas.

Key words: Shark, Seamount, Tooth

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INTRODUCTION

The smalltooth sand-tiger shark, *Odontaspis ferox* (Risso 1810) has a circum-global but irregular distribution, often being associated with deep shelf edges and upper slopes of continents (Compagno 1984; Compagno 2001; Acuña-Marrero, et al. 2013). However, the presence of *O. ferox* has also been recorded at oceanic islands, including the Canary Islands (Barría et al. 2018), Azores (Barcelos et al. 2018), Madeira (Lloris et al. 1991), Cape Verde (Menezes et al. 2004; Wirtz et al. 2013) and Fernando de Noronha (Garla & Garcia Júnior 2006) in the Atlantic Ocean.

O. ferox location records from a single specimen are not uncommon in the literature, such as Bonfil (1995), Sheehan (1998), Garla & Garcia Júnior (2006) and Santander-Neto et al. (2011). Despite their cosmopolitan distribution and large size, with mature females reaching at least 410 cm total length (Fergusson et al. 2008), relatively little is known on the ecology and biology of *O. ferox*, though it is recognised as having low rates of reproduction (one litter of two pups every two years) and relatively fragmented populations (Garla & Garcia Júnior 2006; Barcelos et al. 2018; Barría et al. 2018), contributing to it being listed as Vulnerable under the International Union for Conservation of Nature (Graham et al. 2016).

Most of the first location records for *O. ferox* have, to date, been from sightings by SCUBA divers or, more commonly, shark encounters with fishing gears, including hooking and entanglement. In addition, the first record of *O. ferox* from the South Atlantic was identified from a preserved set of jaws taken from a fishery in northeastern Brazil (Menni et al. 1995). The current study, however, presents not only the first record of *O. ferox* from the mid-ocean Ascension Island, the site of an upcoming Marine Protected Area (MPA) designation, but also the first occurrence of *O. ferox* presence being initially identified from in-situ, discarded teeth.

MATERIAL AND METHODS

Between 19th May and 4th June 2017 a major expedition was launched to study the marine megafauna communities associated with three largely unexplored seamounts lying within the Exclusive Economic Zone of Ascension Island, including two shallow water features (summits < 100 m depth) located close to the mid-Atlantic Ridge 260 – 320 km south east of Ascension (Grattan Seamount and a second unnamed sister peak). In order to survey deep-water demersal fauna, custom-made autonomous underwater video systems, or 'dropcams', developed by the National Geographic Society as described by Turchik et al (2015), were deployed at various locations around the seamounts at depths ranging from 99-2100m. Camera rigs were baited with sardines and suspended 2 m above bottom with a high-definition Sony Handycam HDR-XR520V 12-megapixel camera angled down at the seabed and illumination provided by powerful LED illuminators.

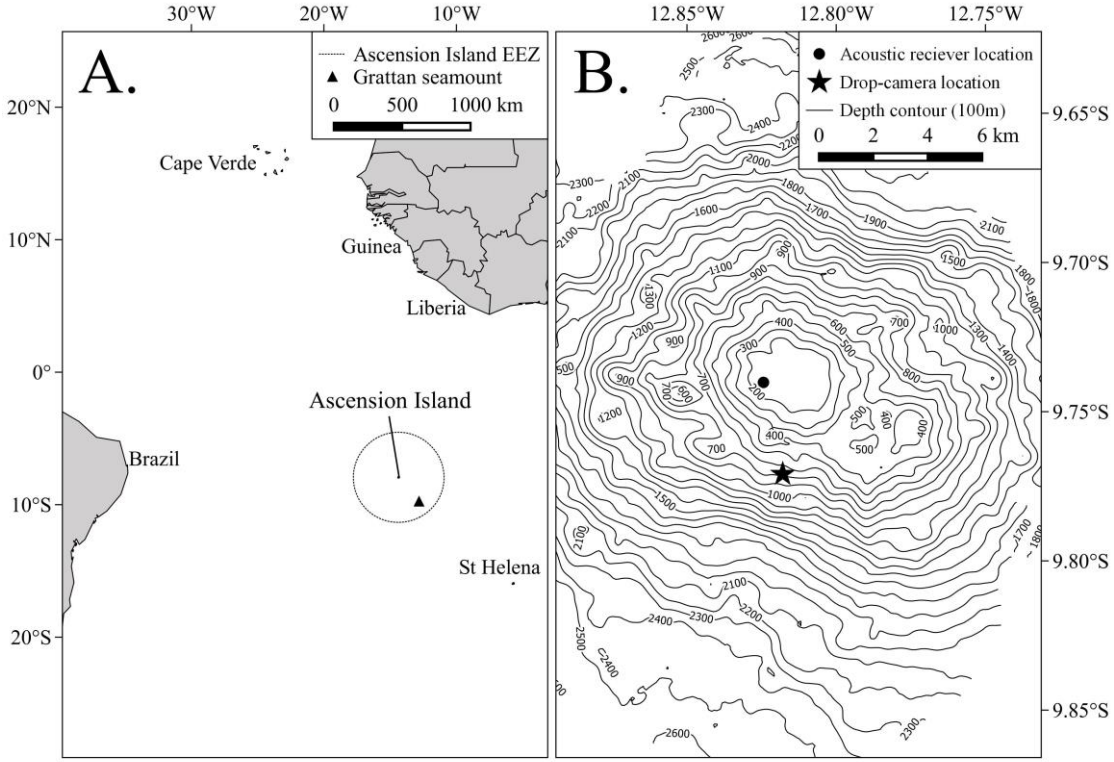

Fig. 1. A. Location of Ascension Island within the Atlantic Ocean and position of the Grattan seamount relative to the Ascension Island 200 NM Exclusive Economic Zone. B. Locations of the Dropcam deployment from which digital stills of *O. ferox* are extracted and the acoustic receiver from which the embedded tooth was recovered on the Grattan seamount.

As part of a longer-term telemetry study of marine megafauna, arrays of acoustic receivers (VR2AR Acoustic Release Receiver, Vemco – Canada www.vemco.com) were also deployed on the summits of both seamounts. Upon retrieval of one unit using a transponding hydrophone on the Grattan seamount (9.74˚S, 12.82˚W) (Figure 1) damage to cold-shrink tape wrapping on the unit, used as an anti-foul measure, was observed. The receiver had been deployed to a depth of 130 m, on

the 3rd June 2017 and retrieved at the surface on the 24th January 2018. Upon further inspection a tooth was found embedded in the tape wrapping and had also penetrated a short distance into the casing of the VR2AR receiver unit. The tooth was removed and stored dry for subsequent identification.

RESULTS

Examination of the embedded tooth found it to be single-cusped, labio-lingually flattened and having smooth cutting edges. Crucially to species identification were two pairs of prominent lateral cusplets adjacent to the basal edge of the crown (Figure 2). Using these diagnostic features, the tooth was unambiguously identified to the smalltooth sandtiger, *Odontaspis ferox* (FAO, 2002). The tooth had an overall length of 12.60 mm, enamel height of 5.25 mm, maximum width of 5.15 mm and maximum lateral cusplet length of 2.98 mm. Further information on shark size, jaw position or orientation was not available from the single tooth specimen.

Fig. 2. Lateral view of the tooth, following removal from the acoustic receiver housing.

O. ferox presence at the Grattan Seamount was further corroborated by dropcam footage filmed contemporaneously with the initial deployment of the acoustic array, but not analysed until 2018 following discovery of the discarded tooth. Upon close examination of archived digital video footage filmed at a depth of 765 m on the southern flank of the seamount (9.771˚S, 12.817˚W), a single *O. ferox* individual was visible for a period of 49 seconds (Figure 3). Diagnostic features used to identify the specimen on film as *O. ferox* were the first dorsal fin being situated closer to the pectoral fins than to the pelvic fins with its rear tip anterior to the pelvic-fin origins, together with a short, asymmetrical caudal fin having a distinct subterminal notch (Bass & Compagno 1986; FAO 2002). Based on the estimated relative lengths of multiple cutthroat eels (Synaphobranchidae) and bluntnose sixgill shark (*Hexanchus griseus*) also visible in footage, the total length of the *O. ferox* specimen was approximated to be 2.0-2.5 m. A CTD mounted on the camera rig indicated an ambient water temperature of 5.0°C and dissolved oxygen saturation of 44%. On-board temperature sensors in the VR2AR receiver in which the embedded tooth was recovered recorded a daily average of 15.6 – 19.6 °C over the deployment period.

DISCUSSION

This record of *O. ferox* increases the number of shark species confirmed from the Ascension Island Exclusive Economic Zone to 16 and is particularly notable for the unusual circumstances surrounding its collection. Forensic analysis of shark bite traces and damage have been used extensively for investigation of shark attacks on humans (Lowry et al. 2009), but rarely as a method for contributing to species inventories. Although it is not possible to ascertain the exact circumstances or timing of the tooth being embedded in the acoustic receiver body, other incidences of shark species biting into submarine equipment have been reported (Marra 1989). Regardless of the nature of these interactions, the trace evidence left behind proved to be of considerable value in confirming

Fig. 3. Digital video stills of *O. ferox* captured at a depth of 765m on the Grattan Seamount using a baited dropcam system. Images were extracted from footage filmed by a camera rig deployed at 07:42 GMT on 29th May 2017 (photo credit: National Geographic Pristine Seas)

the presence of *O. ferox* at a previously unrecorded location.

The presence of *O. ferox* at Ascension Island's Grattan Seamount, as well as other oceanic island locations such as Madeira and Fernando de Noronha (Lloris et al. 1991; Garla & Garcia Júnior 2006), indicates at least some limited movement by the species across oceanic expanses of many thousands of metres depth, thus necessitating at least one pelagic phase in the life history of some individuals. Indeed, this has been evidenced in the Indian Ocean by recorded catches of *O. ferox* in pelagic areas (Abe et al. 1981; Gubanov 1985).

Nonetheless, it is likely that remote seamounts such as Grattan are important habitats in an otherwise open ocean environment for this demersal species of suspected low productivity (Bonfil 1995; Fergusson et al. 2008). Combined evidence from video footage and recovery of the embedded tooth demonstrate that *O. ferox* is present in benthic habitats at depths ranging from 130 m to at least 765 m on the Grattan Seamount and is clearly active over the summit at times. Given the relative vulnerability of such isolated seamounts to fishing and other anthropogenic pressures, and the often higher biodiversity they support relative to surrounding pelagic habitat, there is mounting evidence of the importance of these submarine peaks as focal points for marine conservation efforts in the deep sea (Watling & Auster 2017). In addition to this uneven distribution of biodiversity between pelagic and seamount systems, the lack of global homogeneity in demersal fish assemblages across seamounts identified by Clark et al (2010) may suggest that the ecological and conservation value of seamounts is not consistent on a global scale. Considering the announcement, in September 2016, that Her Majesty's UK Government would, by 2019, create a marine protected area at Ascension Island covering at least 50% of the island's ~440,000 km^2 exclusive economic zone, seamounts and other bathymetric features around Ascension Island are surely strong candidates for protection.

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REFERENCES

Abe, T., S.P. Applegate, J. Toda, Y. Kakizawa, K. Fukui, H. Fujii and H. Simma 1981. Deep-sea sharks and squalene 1. Notes on the basking shark and ragged-tooth shark. *Proceedings of the Biology of Very Deep Waters of the Pacific Ocean*, Vladivostok, DVNTs AN USSR. Pp.50–53.

Acuña-Marrero, D., J.S. Zimmerhackel, J. Mayorga and A. Hearn 2013. First record of three shark species, *Odontaspis ferox*, *Mustelus albipinnis* and *Centrophorus squamosus*, from the Galápagos Islands. *Marine Biodiversity Records* 6.

Barcelos, L.M.D., J. Azevedo, J. Pollerspöck and J.P. Barreiros 2018. Review of the records of the smalltooth sand tiger shark, *Odontaspis ferox* (Elasmobranchii: Lamniformes: Odontaspididae), in the Azores. *Acta Ichthyologica et Piscatoria* 48(2): 189-194.

Barría, C., A.I. Colmenero, A. del Rosario and F. del Rosario 2018. Occurrence of the vulnerable smalltooth sand tiger shark, *Odontaspis ferox*, in the Canary Islands, first evidence of philopatry. *Journal of Applied Ichthyology* 34(3): 684-686.

Bass, A.J. and L.J.V. Compagno 1986. Odontaspididae. Pp. 104-105 in: Smith, M.M. and P.C. Heemstra (Eds) *Smiths' Sea Fishes*. Springer-Verlag, Berlin.

Bonfil, R. 1995. Is the ragged-tooth shark cosmopolitan? First record from the western North Atlantic. *Journal of Fish Biology* 47: 341–344.

Clark, M.R., F. Althaus, A. Williams, E. Niklitschek, G.M. Menezes, N.R. Hareide, P. Sutton and C. O'Donnell 2010. Are deep-sea demersal fish assemblages globally homogenous? Insights from seamounts. *Marine Ecology* 31: 39-51.

Compagno, L.J.V. 1984. FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Parts 1 & 2. *FAO Fisheries Synopsis* 125.

Compagno L.J.V. 2001. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Volume 2. Bullhead, mackerel and carpet sharks (Heterodontiformes, Lamniformes and Orectolobiformes). No. 1, Volume 2. Rome: FAO, 269 Pp.

FAO: Food and Agriculture Organization of the United Nations (2002) The living marine resources of the Western Central Atlantic. Volume 1: Introduction, molluscs, crustaceans, hagfishes, sharks, batoid fishes, and chimaeras. Carpenter, K.E. (Ed.) FAO Species Identification Guide for Fishery Purposes Pp. 1-600.

Fergusson I.K., Graham K.J. and Compagno L.J.V. 2008. Distribution, abundance and biology of the smalltooth sandtiger shark *Odontaspis ferox* (Lamniformes: Odontaspididae). Environmental *Biology of Fishes* 81: 207–228.

Garla R.C. and J. Garcia-Júnior 2006. Occurrence of the ragged-tooth shark, *Odontaspis ferox*, at Fernando de Noronha Archipelago, western equatorial Atlantic. *Marine Biodiversity Records* 1, E38. doi:10.1017/S1755267206003952

Graham K.J., D.A. Pollard, I. Gordon, S. Williams, A.A. Flaherty, I. Fergusson and M. Dicken 2016. *Odontaspis ferox*. *IUCN Red List of Threatened Species 2016*: e.T41876A103433002 [Accessed 11/07/2018].

Gubanov, E.P. 1985. Presence of the sharp tooth sand shark, *Odontaspis ferox* (Odontaspididae), in the open waters of the Indian Ocean. *Journal of Ichthyology* 25: 156–158.

Lloris, D., J. Rucabado and H. Figueroa 1991. Biogeography of the Macaronesian ichthyofauna. *Boletim do Museu Municipal do Funchal* 43: 191-241.

Lowry, D., A.L.F. de Castro, K. Mara, L.B. Whitenack, B. Delius, G.H. Burgess and P. Motta 2009. Determining shark size from forensic analysis of bite damage. *Marine Biology* 156(12): 2483-2492.

Marra, L.J. 1989. Sharkbite on the SL submarine lightwave cable system: history, causes and resolution. *IEEE Journal of Oceanic Engineering*, 14(3): 230-237.

Menezes, G.M., O. Tariche, M.R. Pinho, P.N. Duarte, A. Fernandes and M.A. Aboim 2004. Annotated list of fishes caught by the R/V ARQUIPÉLAGO off the Cape Verde archipelago. *Arquipelago*. Life and Marine Sciences 21A: 57-71.

Menni, R.C., F.H.V. Hazin and R.P.T. Lessa 1995. Occurrence of the ragged-tooth shark, *Odontaspis ferox*, in the western equatorial Atlantic. *Chondros* 5(4): 3.

Santander-Neto, J., V.V. Faria, A.L. Castro and G.H. Burgess 2011. New record of the rare ragged-tooth shark, *Odontaspis ferox* (Chondrichthyes: Odontaspidae) from the south-west Atlantic identified using DNA bar coding. *Marine Biodiversity Records* 4. doi: 10.1017/S17552672110006698

Sheehan T.F. 1998. First record of the ragged-tooth shark, *Odontaspis ferox*, off the US Atlantic coast. *Marine Fisheries Review* 60: 33–34.

Turchik, A.J., E.J. Berkenpas, B.S. Henning and C.M. Shepard 2015. The deep ocean Dropcam: A highly deployable benthic survey tool. OCEANS 2015-MTS/IEEE Washington (Pp. 1-8).

Watling, L. and P.J. Auster 2017. Seamounts on the high seas should be managed as vulnerable marine ecosystems. *Frontiers in Marine Science* 4. DOI: 10-338/fmars.2017.00014

Wirtz, P., A. Brito, J.M. Falcon, R. Freitas, R. Fricke, V. Monteiro, F. Reiner and O. Tariche 2013. The coastal fishes of the Cape Verde Islands–new records and an annotated check-list. *Spixiana* 36(1):113-142.

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